Water and Microphysical Measurements in Tropical Storm Chantal (8/20/2001)

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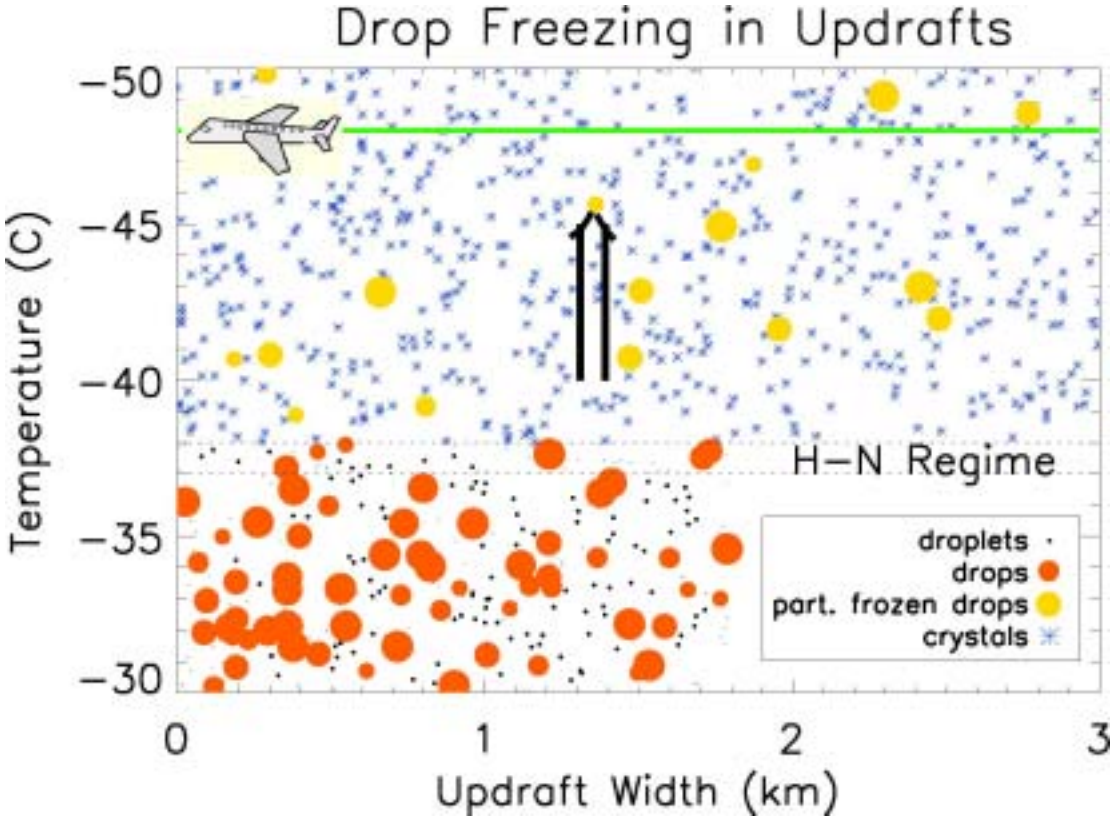
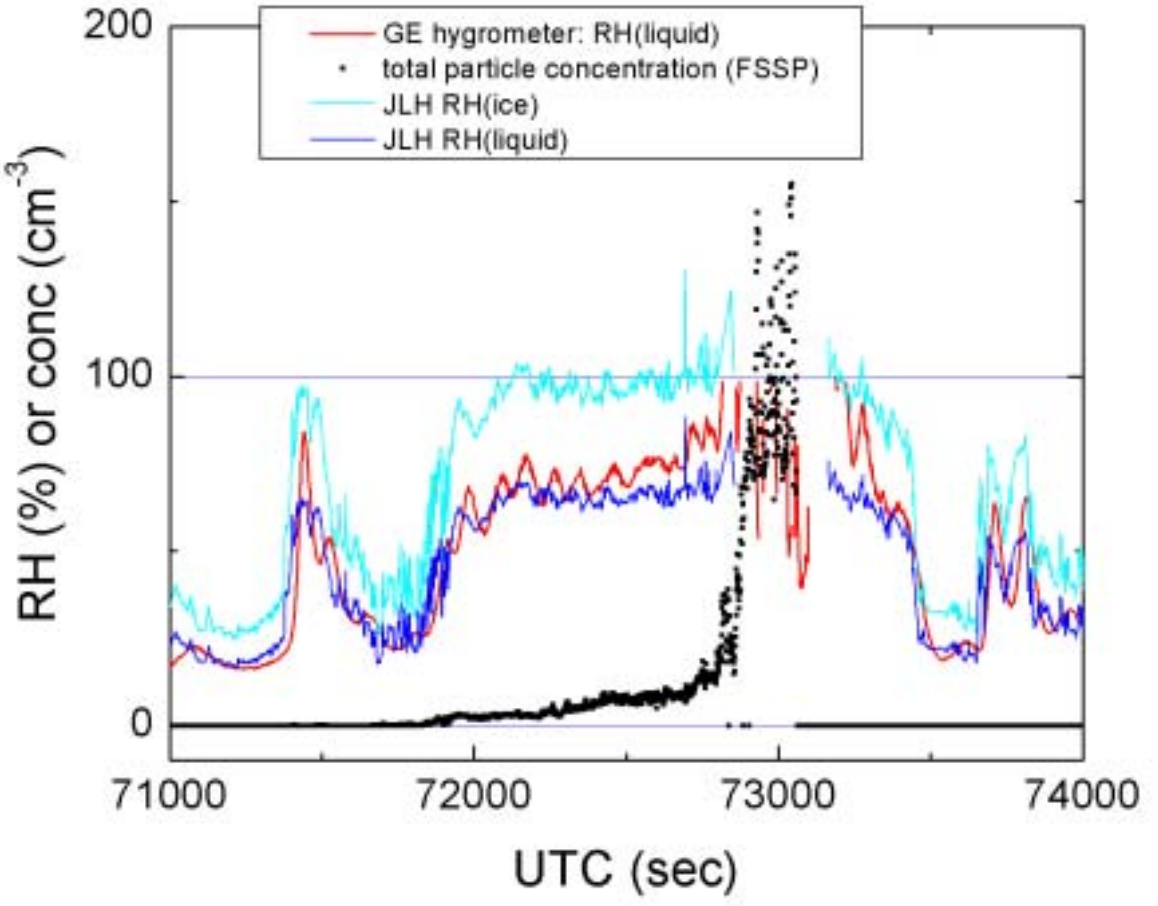
Updraft microphysics



- What is the relative humidity in intense updrafts?
- Are the particles liquid, solid, or a water-ice mixture?

Observations at 73000 sec

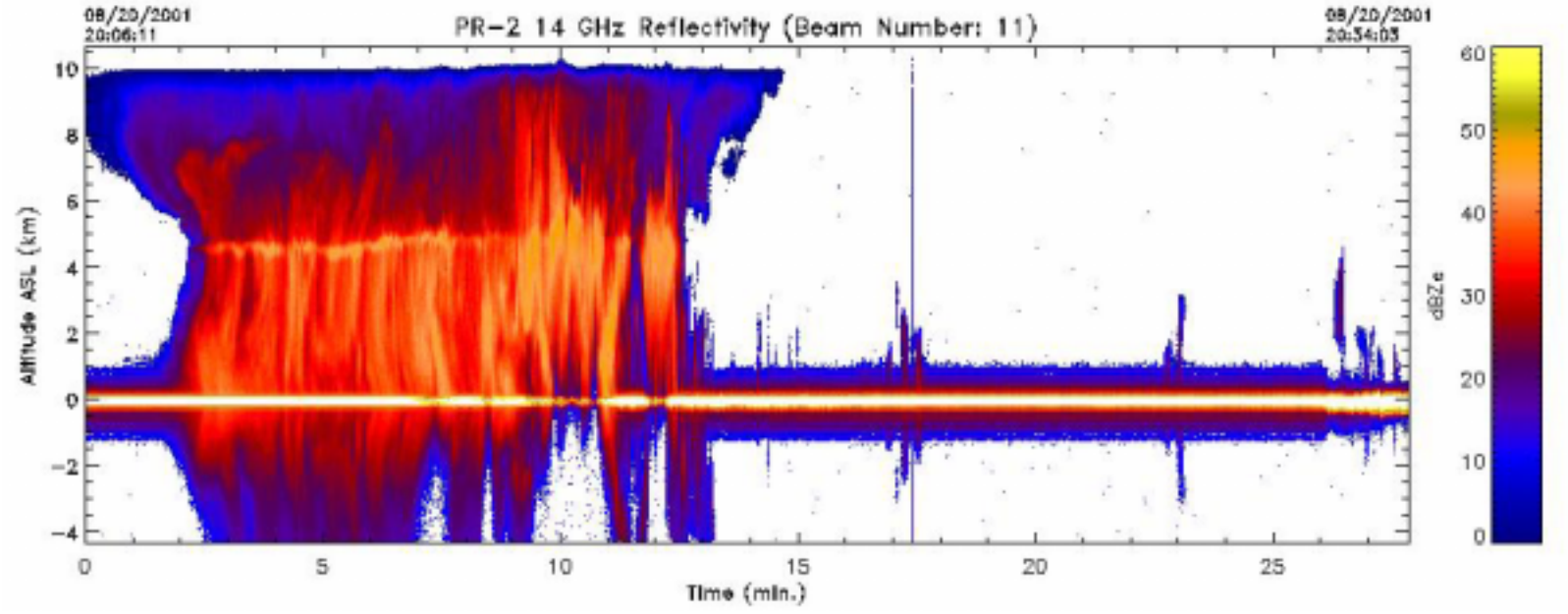
- Intense convection (updraft up to 21.3 m/s).
- Pitot tubes became plugged.
- Precipitation on cockpit windshield, including liquid.
- Video indicates adhesion and possibly streaking on a forward-facing window.
- Video indicates a large conc of mm-sized particles (graupel) within the strongest updraft.
- Large concentration of small particles (15 μm).
- Temperature of –40 C.

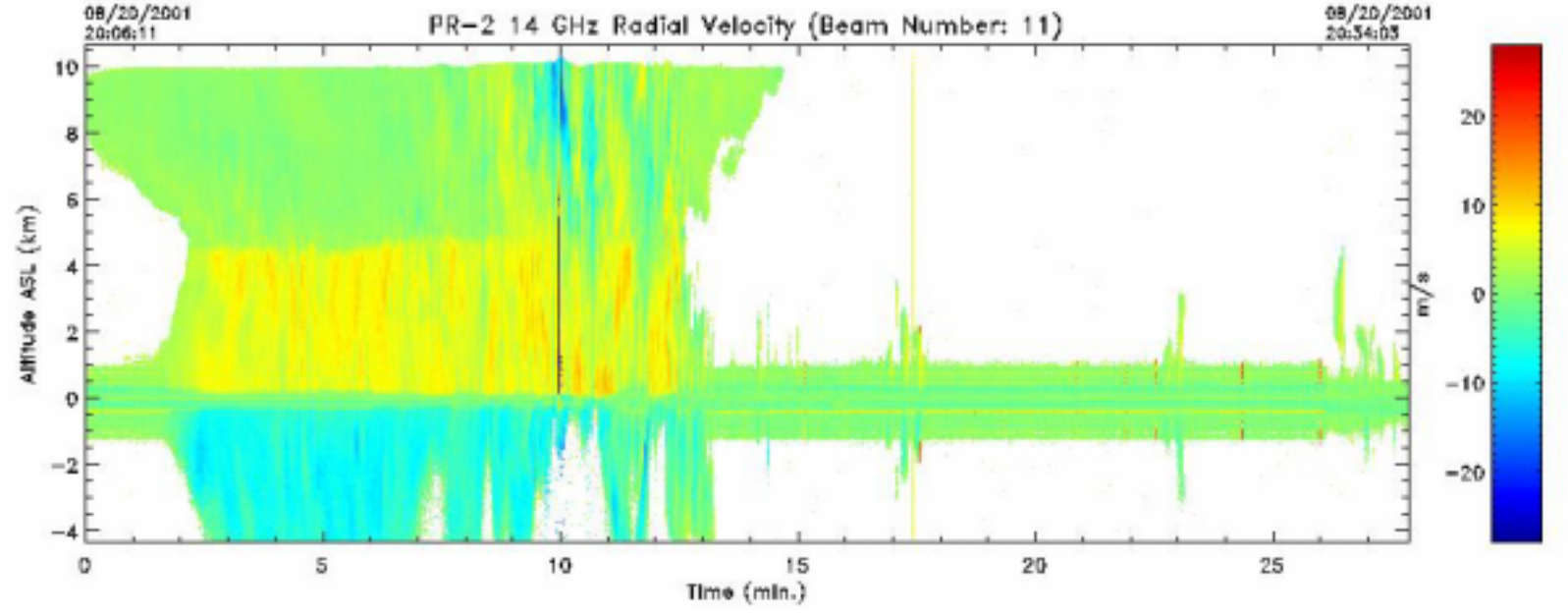


- JLH is accurate (±10% of meas.), except in highest particle concentrations.
- max 30% supersaturation (ice) or 96% relative humidity (water) in Chantal.

JPL Precipitation Radar (PR-2)

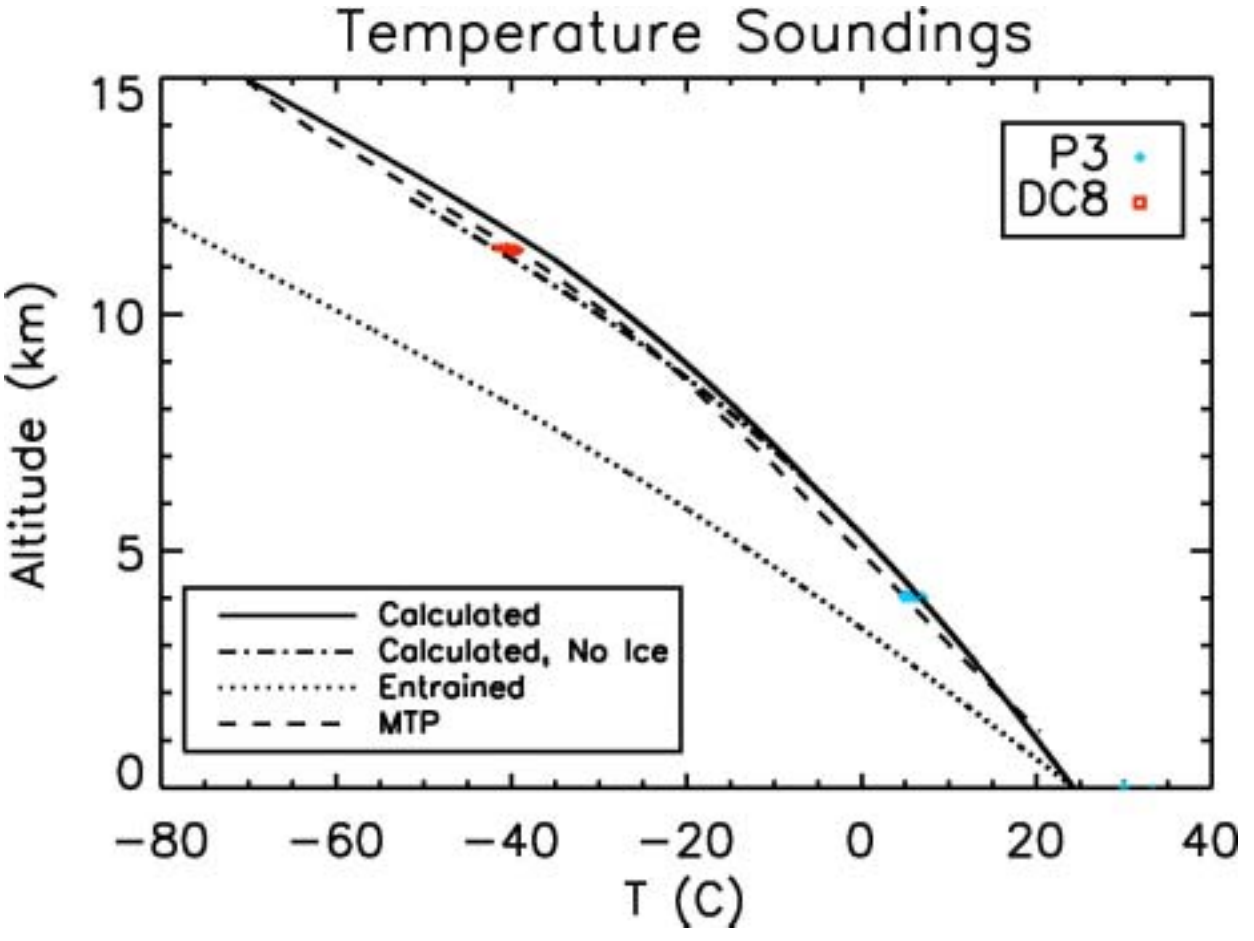
(E. Im, prelim. data)





Moist adiabatic convection

- Model temp matches measurements
- Moist adiabat
- No entrainment
- Use to parameterize microphysical model



Updraft microphysics model

- Constraints: w = 20 m/s, and homogeneous freezing starts at –30 C.
- mm-sized drops fall relative to air parcel, and are frozen by -32 C.
- The only way to maintain partially frozen droplets at –40 C is through low-density growth (riming)
- Small particles freeze quickly…
- But large particles have low upward velocity…
- Therefore, mm-sized particles have the best chance of staying partially liquid in strong updrafts.
- Conclusion: At -40 C, mixed-phase particles with low-density riming, but ice at -46 and -50 C.